

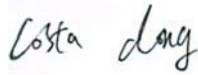
FCC PART 90 TEST REPORT

For

Northfield Telecommunications, Inc. d/b/a Advanced Wireless Communications

20809 Kensington Blvd, Lakeville, Minnesota, 55044-8385, USA

FCC ID: Q9SAWR-ERM100

Report Type: Original Report	Product Type: Embedded radio module
Test Engineer: <u>Costa Dong</u>	
Report Number: <u>RDG160728008-00A</u>	
Report Date: <u>2016-08-16</u>	
Reviewed By: <u>Sula Huang</u> RF Leader	
Test Laboratory:	Bay Area Compliant Laboratories Corp. (Dongguan) No.69 Pulongcun, Puxinhu Industrial Zone, Tangxia, Dongguan, Guangdong, China Tel: +86-769-86858888 Fax: +86-769-86858891 www.baclcorp.com.cn

Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliant Laboratories Corp.

TABLE OF CONTENTS

GENERAL INFORMATION.....	4
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	4
OBJECTIVE	4
RELATED SUBMITTAL(S)/GRANT(S).....	4
TEST METHODOLOGY	4
TEST FACILITY	4
SYSTEM TEST CONFIGURATION.....	5
DESCRIPTION OF TEST CONFIGURATION	5
SUPPORT EQUIPMENT LIST AND DETAILS	5
EXTERNAL I/O CABLE.....	5
BLOCK DIAGRAM OF TEST SETUP	6
SUMMARY OF TEST RESULTS	7
FCC §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)	8
APPLICABLE STANDARD	8
FCC §2.1046 & §90.205- RF OUTPUT POWER.....	10
APPLICABLE STANDARD	10
TEST PROCEDURE	10
TEST EQUIPMENT LIST AND DETAILS.....	10
TEST DATA	10
FCC §2.1047 & §90.207 - MODULATION CHARACTERISTIC	12
APPLICABLE STANDARD	12
TEST PROCEDURE	12
TEST EQUIPMENT LIST AND DETAILS.....	12
TEST DATA	12
FCC §2.1049&§90.209 & §90.210 – OCCUPIED BANDWIDTH & EMISSION MASK	18
APPLICABLE STANDARD	18
TEST EQUIPMENT LIST AND DETAILS.....	19
TEST PROCEDURE	19
TEST DATA	19
FCC §2.1051& §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS	26
APPLICABLE STANDARD	26
TEST EQUIPMENT LIST AND DETAILS.....	26
TEST PROCEDURE	26
TEST DATA	27
FCC §2.1053 & §90.210 - RADIATED SPURIOUS EMISSIONS	30
APPLICABLE STANDARD	30
TEST EQUIPMENT LIST AND DETAILS.....	30
TEST PROCEDURE	30
TEST DATA	31
FCC §2.1055 & §90.213- FREQUENCY STABILITY.....	33
APPLICABLE STANDARD	33
TEST EQUIPMENT LIST AND DETAILS.....	33
TEST PROCEDURE	33
TEST DATA	33

FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR.....35
 APPLICABLE STANDARD35
 TEST EQUIPMENT LIST AND DETAILS.....35
 TEST PROCEDURE35
 TEST DATA36

FINAL

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The Northfield Telecommunications, Inc. d/b/a Advanced Wireless Communications 's product, model: AWR-ERM100 (FCC ID: Q9SAWR-ERM100) (the "EUT") in this report is a *Embedded radio module*, which was measured approximately: 12.1 cm (L)× 7.5cm (W)× 1.5 cm (H), rated input voltage: DC12V.

Note: The series product, models AWR-ERM100 and AWR-ERM100s are electrically identical, the differences between them is model name, we selected AWR-ERM100 for fully testing, the details was explained in the attached declaration letter.

**All measurement and test data in this report was gathered from production sample serial number: 160728008. The EUT was received on 2016-08-01.*

Objective

This test report is prepared on behalf of Northfield Telecommunications, Inc. d/b/a Advanced Wireless Communications in accordance with Part 2, Part 90 of the Federal Communications Commission rules.

Related Submittal(s)/Grant(s)

No related submittal(s).

Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of federal Regulations Title 47 Part 2, Sub-part J as well as the following individual parts:

Part 90 – Private Land DMR RADIO Service

Applicable Standards: TIA-603-D.

All emissions measurement was performed and Bay Area Compliant Laboratories Corp. (Dongguan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Test Facility

The Test site used by Bay Area Compliant Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industrial Zone, Tangxia, Dongguan, Guangdong, China

Test site at Bay Area Compliant Laboratories Corp. (Dongguan) has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in Compliant with the requirements of Section 2.948 of the FCC Rules on February 06, 2015.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 273710. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in a test mode.

EUT Specification:

Frequency Band	450-470 MHz
Modulation Mode	FM
Channel Spacing	6.25kHz/12.5kHz
Rated RF Output Power	High: 4W, Low: 2W

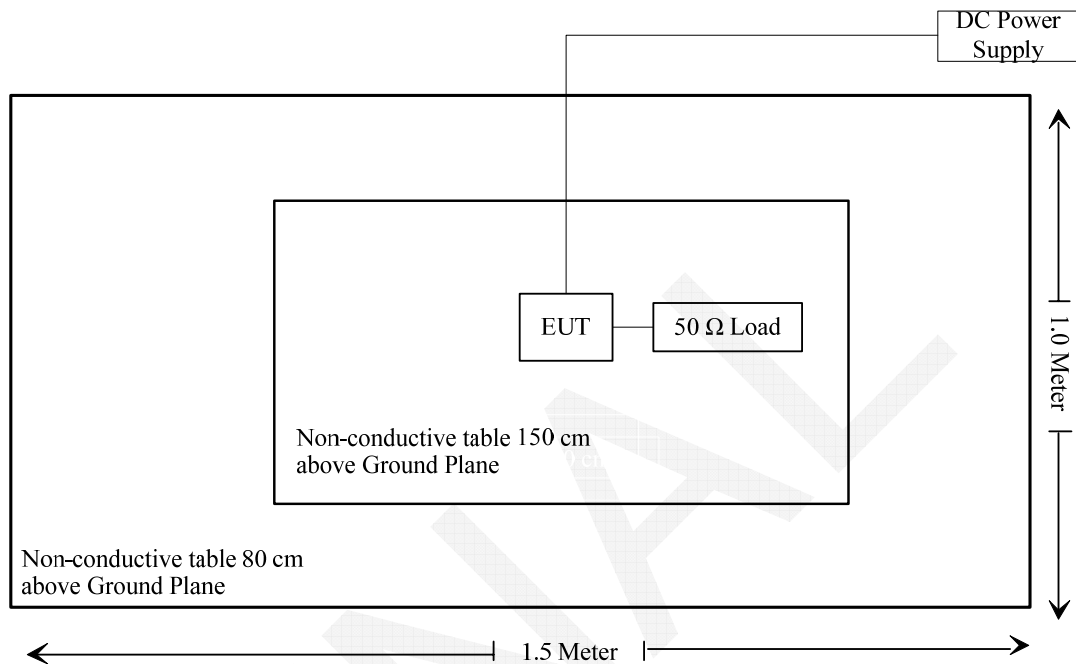
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Weinschel Corp	Terminal Load(100W)	1440-3	MD447
Pro instrument	DC Power Supply	pps3300	N/A

External I/O Cable

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
DC Cable	no	no	1.5	EUT	DC Power Supply

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
§1.1307 (b)(1), §2.1091	Maximum Permissible Exposure (MPE)	Compliant
§2.1046;§90.205	RF Output Power	Compliant
§2.1047;§90.207	Modulation Characteristic	Compliant
§2.1049;§90.209; §90.210	Occupied Bandwidth & Emission Mask	Compliant
§2.1051;§90.210	Spurious Emission at Antenna Terminal	Compliant
§2.1053;§90.210	Spurious Radiated Emissions	Compliant
§2.1055; §90.213	Frequency Stability	Compliant
§90.214	Transient Frequency Behavior	Compliant

FCC §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to 1.1307 (b)(1), 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for Maximum Permissible Exposure (MPE)

Limits for Occupational/Controlled Exposure				
Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm²)	Averaging Time E , H or S (minutes)
0.3- 3.0	614	1.63	(100)*	6
3.0 - 30	1842/f	4.89/f	(900/f ²)*	6
30-300	61.4	0.163	1.0	6
300-1500	/	/	f/300	6
1500-100,000	/	/	5	6

f = frequency in MHz;

* = Plane-wave equivalent power density;

MPE Calculation

Predication of MPE limit at a given distance

$$S = PG/4\pi R^2$$

Where: S = power density (in appropriate units, e.g. mW/cm²);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

Calculated Data:

Frequency	Max Target Output Power	Duty Cycle	Antenna Cable Loss	Typical Antenna Gain		Distance	Power Density	Limit
MHz	mW		dB	dBi	numeric	cm	mW/cm ²	mW/cm ²
450.0125	4100	50%	0	5	3.16	20	1.3	1.5

Note: The manufacturer does not specify an antenna to be used with this device, but a typical installation has a gain up to 5 dBi.

Radio Exposure Statement:

Using the parameters given in the above calculation, a minimum antenna to person distance of 20cm is required to meet the limits for occupational/controlled exposure.

Result: Compliant.

FCC §2.1046 & §90.205- RF OUTPUT POWER**Applicable Standard**

FCC §2.1046 and §90.205.

Test Procedure

Conducted RF Output Power:

TIA-603-D section 2.2.1

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

Spectrum Analyzer setting:

RBW	VBW
100 kHz	300 kHz

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	DE31388	2016-05-09	2017-05-09
AA-MCS	Attenuator(40dB)	CAT-50-40-200-Nm-Nf	0602-010	2016-05-08	2017-05-08
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2016-05-06	2017-05-06
N/A	Coaxial Cable	0.1m	N/A	2016-05-06	2017-05-06

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

Temperature:	28.4°C
Relative Humidity:	53%
ATM Pressure:	100kPa

The testing was performed by Costa Dong on 2016-08-05.

Test Result: Compliant. Please refer to following tables.

Modulation mode	Channel Spacing (kHz)	fc (MHz)	Conducted Output Power (W)		Note
			High	Low	
FM	12.5	450.0125	3.93	2.01	/
		460.0125	3.95	2.04	/
		469.9875	3.99	1.95	/
	6.25	450.0125	3.94	2.09	/
		460.0125	4.04	1.97	/
		469.9875	3.99	2.05	/

Note: The rated high power is 4W (36 dBm) and low power is 2W (33 dBm).

FCC §2.1047 & §90.207 - MODULATION CHARACTERISTIC

Applicable Standard

FCC§2.1047 & §90.207:

- (a) Equipment which utilizes voice modulated communication shall show the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz. for equipment which is required to have a low pass filter, the frequency response of the filter, or all of the circuitry installed between the modulation limited and the modulated stage shall be supplied.
- (b) Equipment which employs modulation limiting, a curve showing the percentage of modulation versus the modulation input voltage shall be supplied.

Test Procedure

Test Method: TIA/EIA-603D 2.2.3

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
HP	RF Communications Test Set	8920A	00 235	2016-05-09	2017-05-09
AA-MCS	Attenuator(40dB)	CAT-50-40-200-Nm-Nf	0602-010	2016-05-08	2017-05-08
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2016-05-06	2017-05-06
N/A	Coaxial Cable	0.1m	N/A	2016-05-06	2017-05-06

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	28.4°C
Relative Humidity:	53%
ATM Pressure:	100kPa

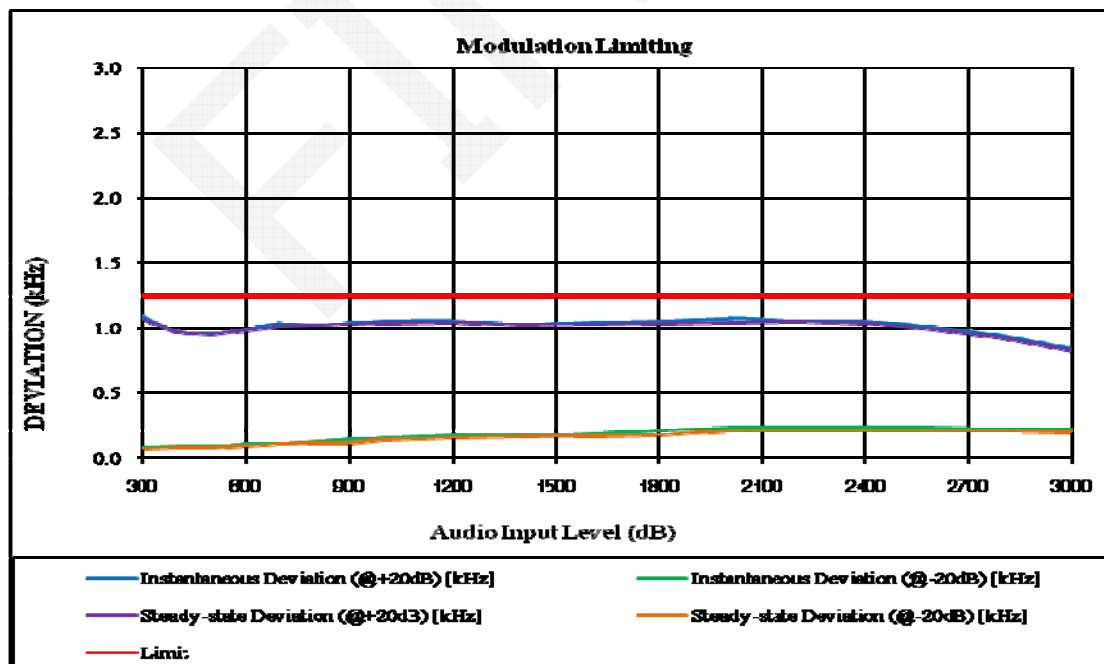
The testing was performed by Costa Dong on 2016-08-05.

Test Result: Compliant. Please refer to following table and plots.

MODULATION LIMITING

Carrier Frequency: 460.0125 MHz, Channel Spacing = 6.25 kHz

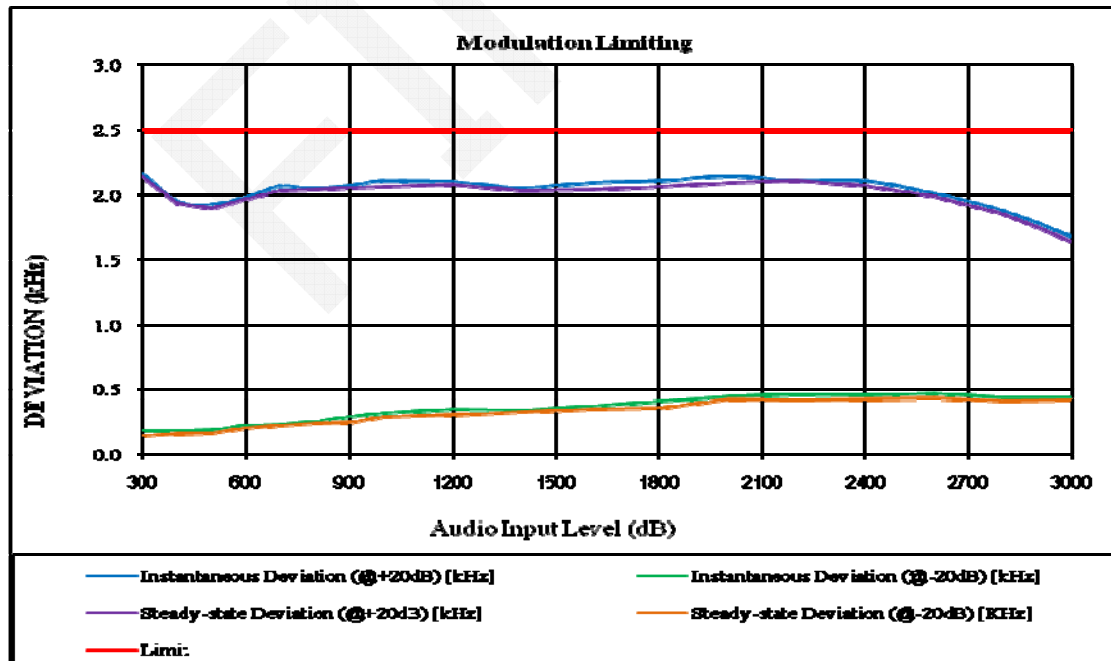
Audio Frequency (Hz)	Instantaneous		Steady-state		Result
	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	
300	1.081	0.084	1.068	0.072	Pass
400	0.973	0.091	0.966	0.078	Pass
500	0.963	0.092	0.950	0.08	Pass
600	0.99	0.114	0.982	0.10	Pass
700	1.033	0.114	1.014	0.11	Pass
800	1.023	0.127	1.021	0.116	Pass
900	1.034	0.144	1.028	0.121	Pass
1000	1.049	0.16	1.036	0.144	Pass
1200	1.053	0.175	1.041	0.155	Pass
1400	1.028	0.173	1.018	0.164	Pass
1600	1.045	0.189	1.025	0.173	Pass
1800	1.051	0.207	1.034	0.178	Pass
2000	1.07	0.223	1.046	0.213	Pass
2200	1.055	0.226	1.055	0.209	Pass
2400	1.052	0.227	1.035	0.211	Pass
2600	1.008	0.229	0.988	0.213	Pass
2800	0.937	0.22	0.923	0.212	Pass
3000	0.839	0.216	0.821	0.206	Pass



Note: For channel spacing: 6.25 kHz, the full system rated deviation is 1.25 kHz which specified by manufacturer.

Carrier Frequency: 460.0125 MHz, Channel Spacing = 12.5 kHz

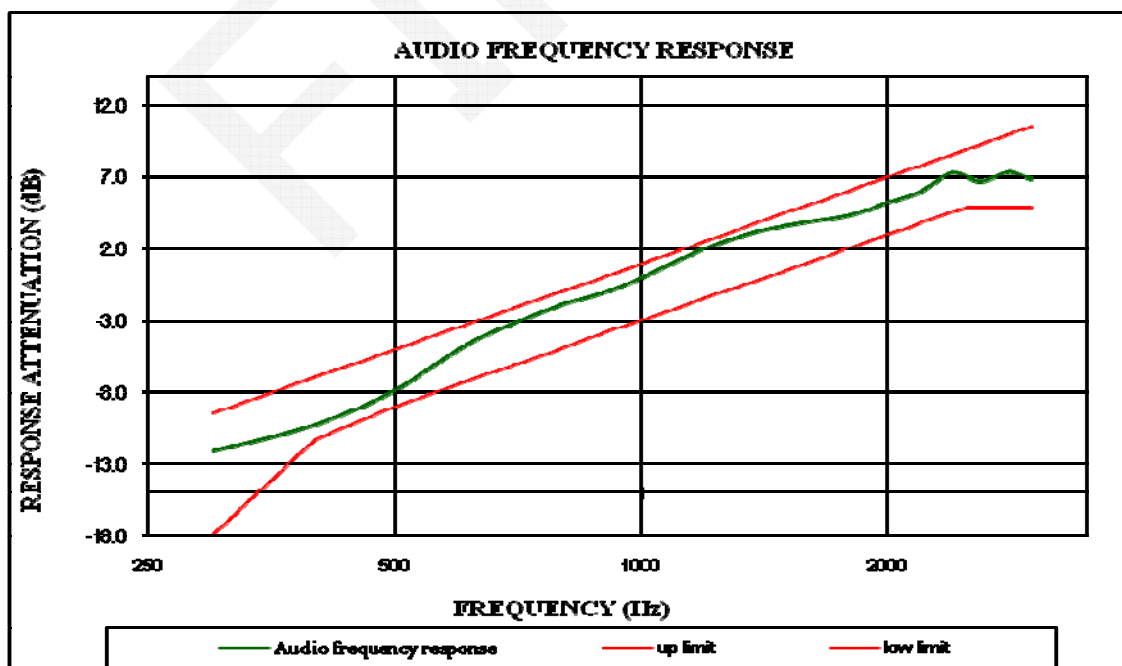
Audio Frequency (Hz)	Instantaneous		Steady-state		Limit [kHz]
	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	
300	2.163	0.177	2.142	0.14	2.5
400	1.953	0.181	1.939	0.157	2.5
500	1.927	0.19	1.902	0.167	2.5
600	1.983	0.227	1.966	0.205	2.5
700	2.071	0.236	2.036	0.225	2.5
800	2.055	0.259	2.043	0.24	2.5
900	2.072	0.296	2.057	0.247	2.5
1000	2.108	0.324	2.069	0.296	2.5
1200	2.102	0.356	2.08	0.312	2.5
1400	2.056	0.35	2.034	0.329	2.5
1600	2.096	0.379	2.047	0.352	2.5
1800	2.108	0.418	2.07	0.36	2.5
2000	2.149	0.446	2.093	0.428	2.5
2200	2.112	0.457	2.11	0.424	2.5
2400	2.109	0.456	2.077	0.43	2.5
2600	2.012	0.467	1.987	0.438	2.5
2800	1.879	0.44	1.851	0.418	2.5
3000	1.677	0.439	1.643	0.421	2.5



Audio Frequency Response

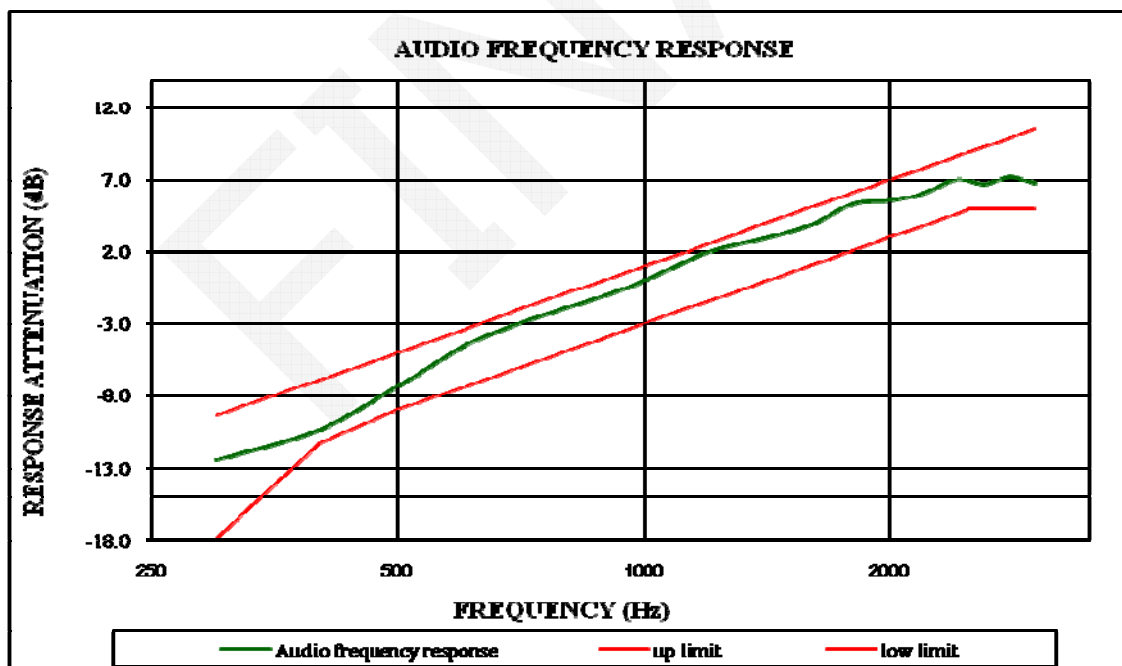
Carrier Frequency: 460.0125 MHz, Channel Spacing = 6.25 kHz, high power level

Audio Frequency	Response Attenuation
Hz	dB
300	-12.06
400	-10.22
500	-7.89
600	-5.01
700	-3.14
800	-1.88
900	-1.02
1000	0.00
1200	2.08
1400	3.29
1600	3.91
1800	4.37
2000	5.23
2200	6.04
2400	7.28
2600	6.69
2800	7.32
3000	6.87



Carrier Frequency: 460.0125 MHz, Channel Spacing = 12.5 kHz, high power level

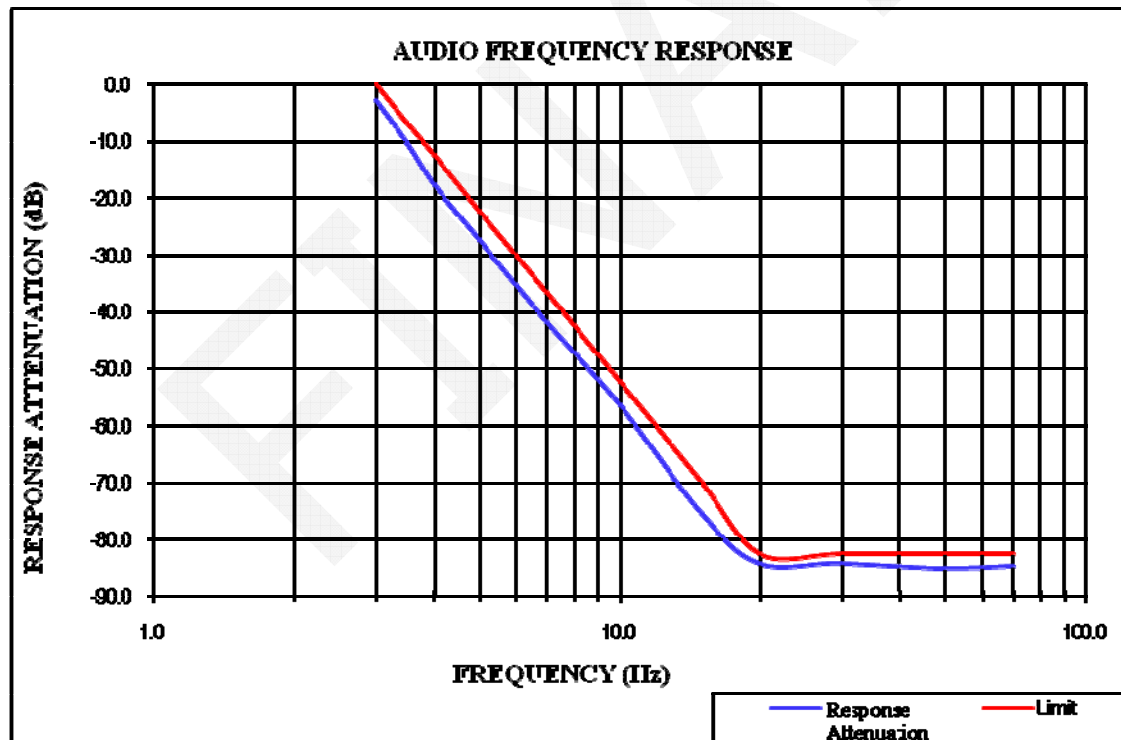
Audio Frequency	Response Attenuation
Hz	dB
300	-12.46
400	-10.45
500	-7.36
600	-4.55
700	-2.99
800	-1.97
900	-1.05
1000	0.00
1200	1.98
1400	2.88
1600	3.81
1800	5.30
2000	5.51
2200	6.03
2400	7.01
2600	6.71
2800	7.19
3000	6.75



Audio Frequency Low Pass Filter Response

Carrier Frequency: 460.0125 MHz, Channel Spacing = 12.5 kHz, high power level

Audio Frequency	Response Attenuation	Limit
kHz	dB	dB
3.0	-2.7	0.0
3.5	-10.1	-6.7
4.0	-17.7	-12.5
5.0	-27.3	-22.2
7.0	-42.0	-36.8
10.0	-56.4	-52.3
15.0	-75.6	-69.9
20.0	-84.3	-82.5
30.0	-84.2	-82.5
50.0	-85.0	-82.5
70.0	-84.7	-82.5



FCC §2.1049&§90.209 & §90.210 – OCCUPIED BANDWIDTH & EMISSION MASK

Applicable Standard

FCC §2.1049, §90.209 and §90.210

Applicable Emission Masks		
Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
Below 25	A or B	A or C
25-50	B	C
72-76	B	C
150-174	B, D, or E	C, D or E
150 paging only	B	C
220-222	F	F
421-512	B, D, or E	C, D, or E
450 paging only	B	G
806-809/851-854	B	H
809-824/854-869	B	G
896-901/935-940	I	J
902-928	K	K
929-930	B	G
4940-4990 MHz	L or M	L or M
5850-5925		
All other bands	B	C

Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- (1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 : Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.27(f_d - 2.88 \text{ kHz})$ dB.
- (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least $50 + 10 \log (P)$ dB or 70 dB, whichever is the lesser attenuation.
- (4) The reference level for showing Compliant with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show Compliant with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	DE31388	2016-05-09	2017-05-09
HP	RF Communications Test Set	8920A	00 235	2016-05-09	2017-05-09
AA-MCS	Attenuator(40dB)	CAT-50-40-200-Nm-Nf	0602-010	2016-05-08	2017-05-08
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2016-05-06	2017-05-06
N/A	Coaxial Cable	0.1m	N/A	2016-05-06	2017-05-06

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

Test Data**Environmental Conditions**

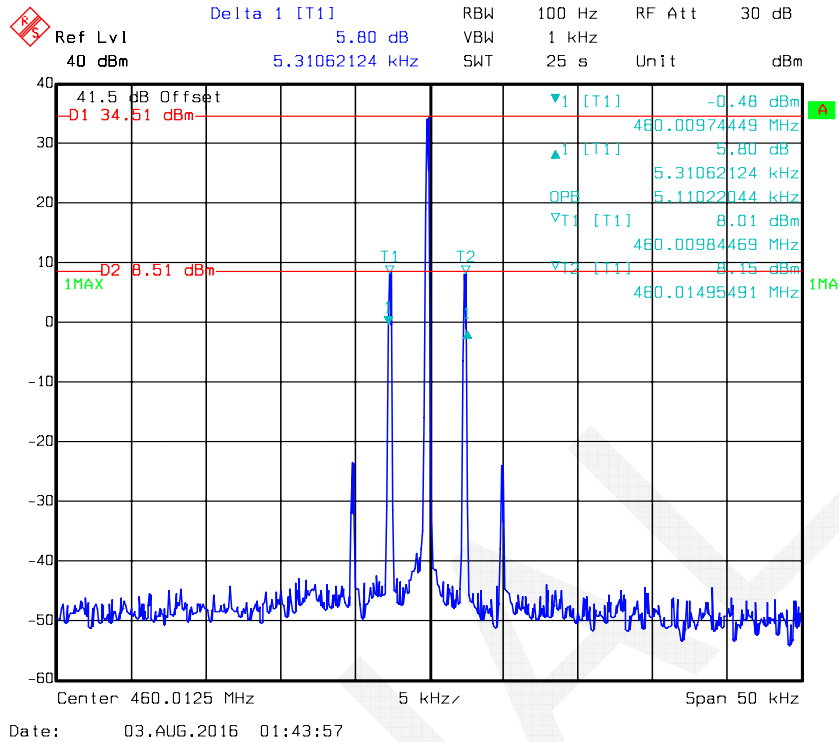
Temperature:	27.2~29.5 °C
Relative Humidity:	46~63 %
ATM Pressure:	99.4~100.2kPa

The testing was performed by Costa Dong from 2016-08-02 to 2016-08-10.

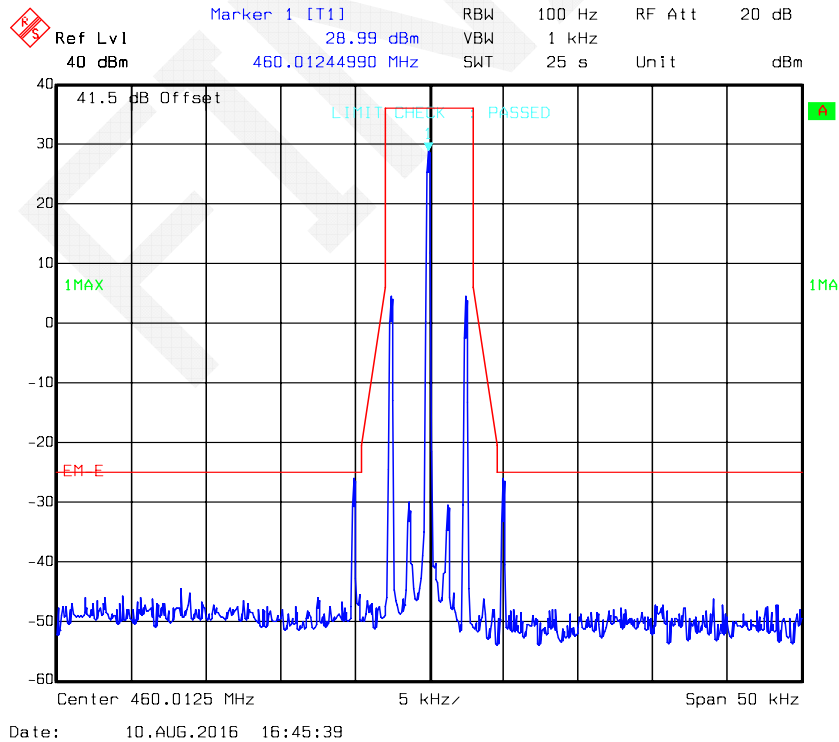
Test Result: Compliant. Please refer to the following tables and plots.

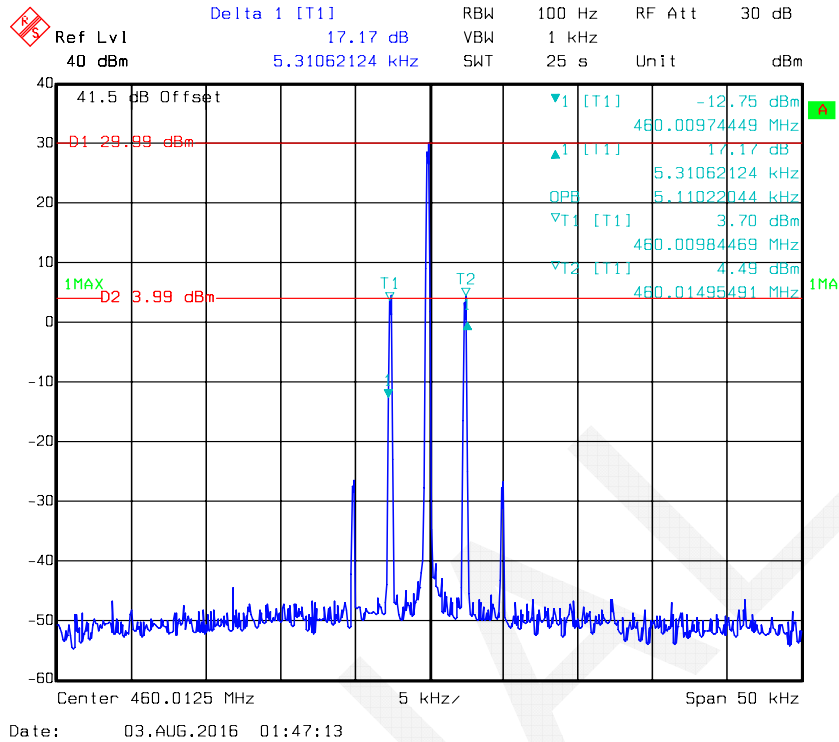
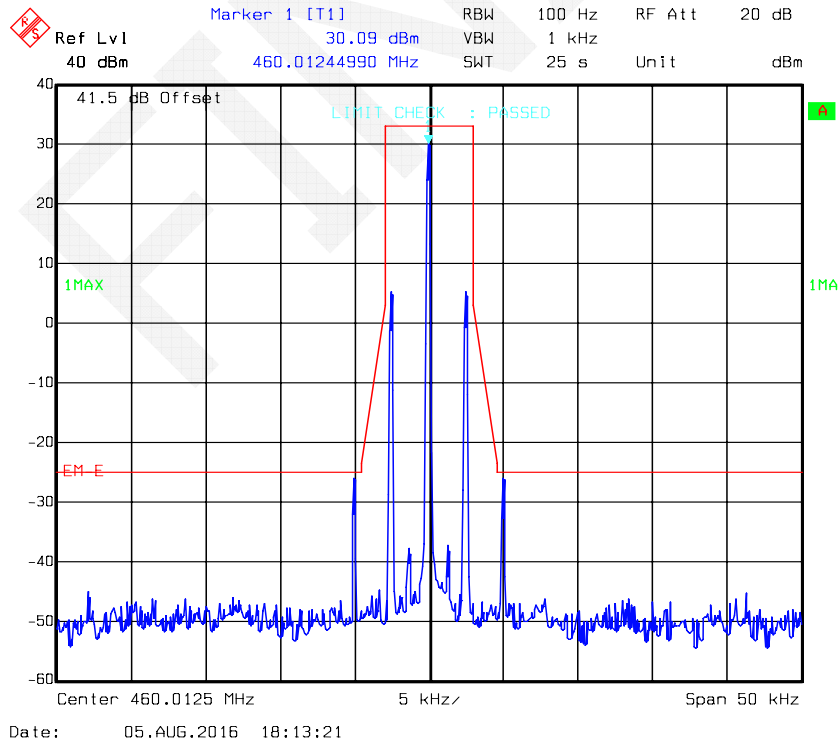
Modulation Mode	Channel Spacing (kHz)	f_c	99% Occupied Bandwidth	26 dB Bandwidth	Power Level
		(MHz)	(kHz)	(kHz)	
FM	6.25	460.0125	5.11	5.31	High
	12.5		5.31	10.32	
	6.25		5.11	5.31	Low
	12.5		5.31	10.32	
	6.25	453.2125	5.11	5.31	High
	12.5		5.31	10.32	
	6.25		5.11	5.31	Low
	12.5		5.31	10.32	

Occupied Bandwidth – 6.25 kHz 460.0125 MHz, High Power Level

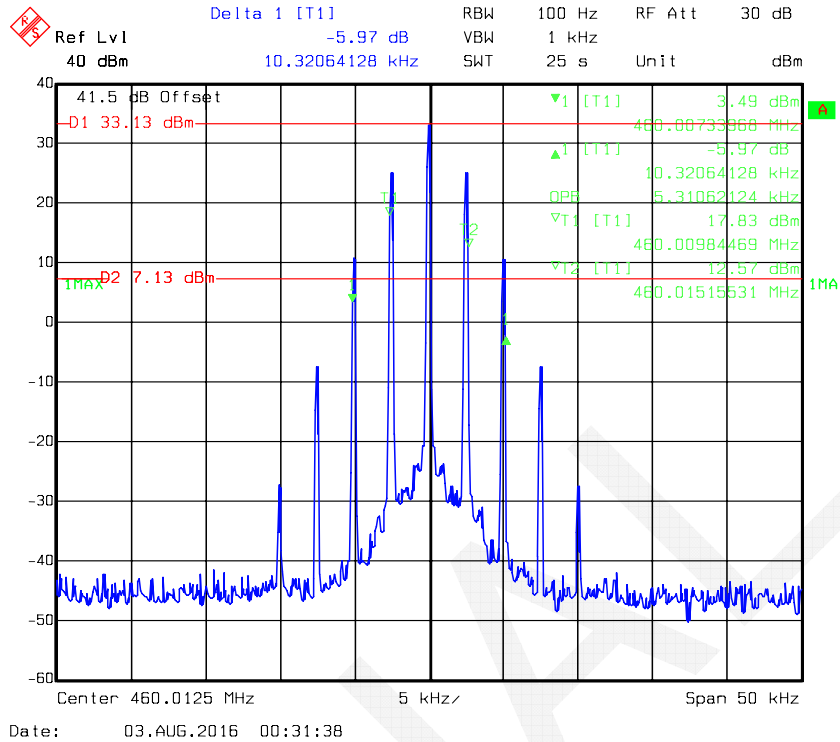


Emission Mask - Type D

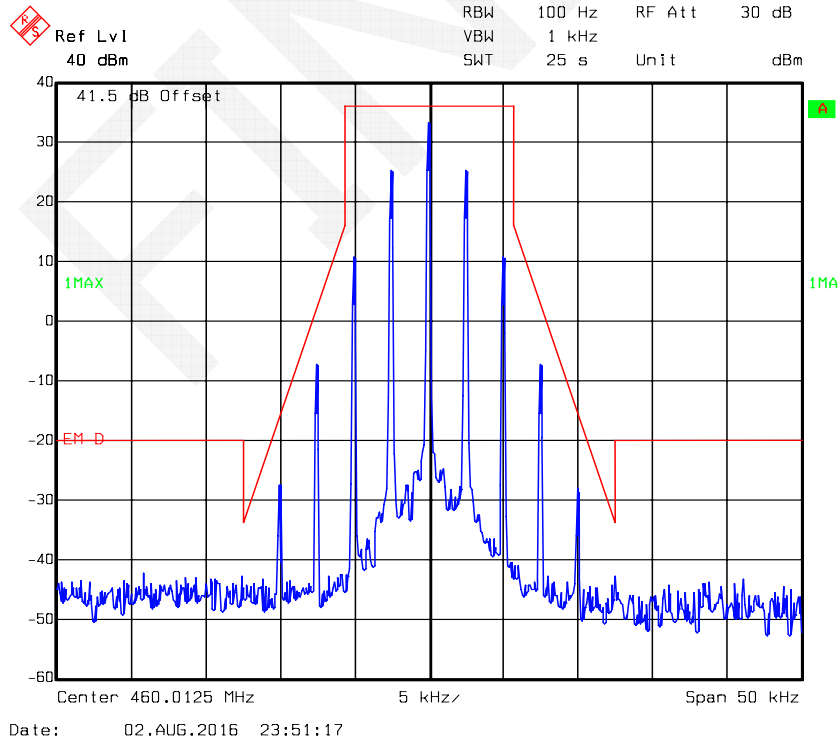


Occupied Bandwidth –6.25 kHz 460.0125 MHz, Low Power Level**Emission Mask - Type D**

Occupied Bandwidth – 12.5 kHz 460.0125 MHz, High Power Level



Emission Mask - Type D



Ref Lvl
40 dBm

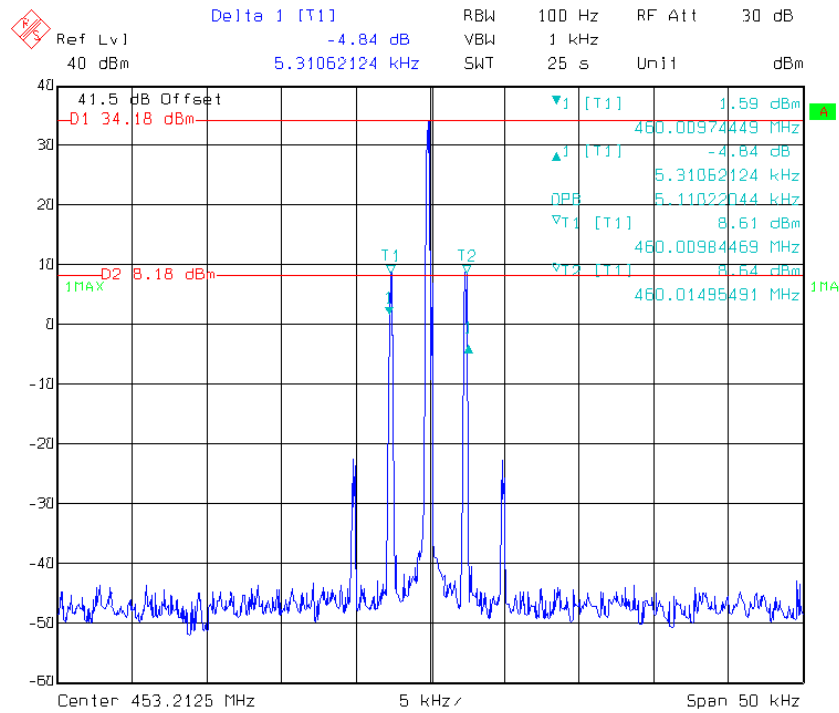
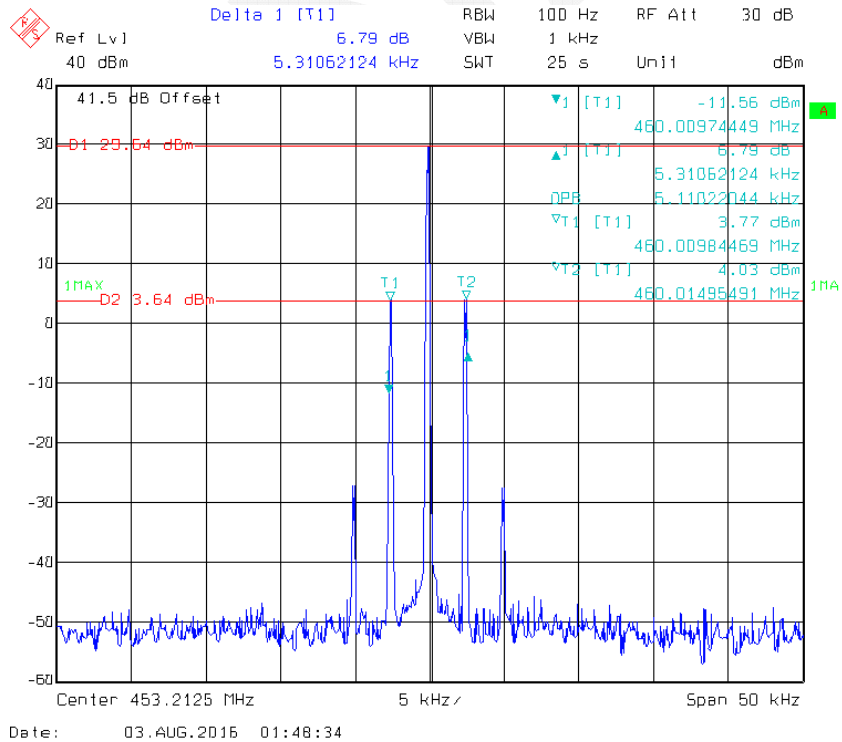
RBW 100 Hz
VBW 1 kHz
SWT 25 s
RF Att 30 dB
Unit dBm

41.5 dB Offset

EM D

1MAX

Center 460.0125 MHz
5 kHz/
Span 50 kHz

Occupied Bandwidth –6.25 kHz 453.2125 MHz, High Power Level**Occupied Bandwidth –6.25 kHz 453.2125 MHz, Low Power Level**

Delta 1 [T1]

Ref Lvl	-2.02 dB	RBW	100 Hz	RF Att	30 dB
40 dBm	10.32064128 kHz	VBW	1 kHz		
		SWT	25 s	Unit	dBm

41.5 dB Offset

-01 32.93 dBm

D2 6.93 dBm

T1 [T1] -0.74 dBm
460.0873360 MHz

T2 [T1] -2.02 dB
10.32064128 kHz

NPR 5.31052124 kHz

T1 [T1] 14.22 dBm
460.00984469 MHz

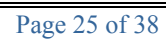
T2 [T1] 12.28 dBm
460.01515531 MHz

Center 453.2125 MHz

5 kHz /

Span 50 kHz

Occupied Bandwidth –12.5 kHz, 453.2125 MHz, Low Power Level



FCC §2.1051& §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Applicable Standard

Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- (1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 : Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.27(f_d - 2.88 \text{ kHz})$ dB.
- (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least $50 + 10 \log(P)$ dB or 70 dB, whichever is the lesser attenuation.
- (4) The reference level for showing Compliant with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show Compliant with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	831259/019	2016-05-09	2017-05-09
AA-MCS	Attenuator(40dB)	CAT-50-40-200-Nm-Nf	0602-010	2016-05-08	2017-05-08
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2016-05-06	2017-05-06
N/A	Coaxial Cable	0.1m	N/A	2016-05-06	2017-05-06

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

Adjust the spectrum analyzer for the following settings:

- 1) Resolution Bandwidth = 100 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1 GHz.
- 2) Video Bandwidth ≥ 3 times the resolution bandwidth.
- 3) Sweep Speed ≤ 2000 Hz per second.
- 4) Detector Mode = mean or average power.

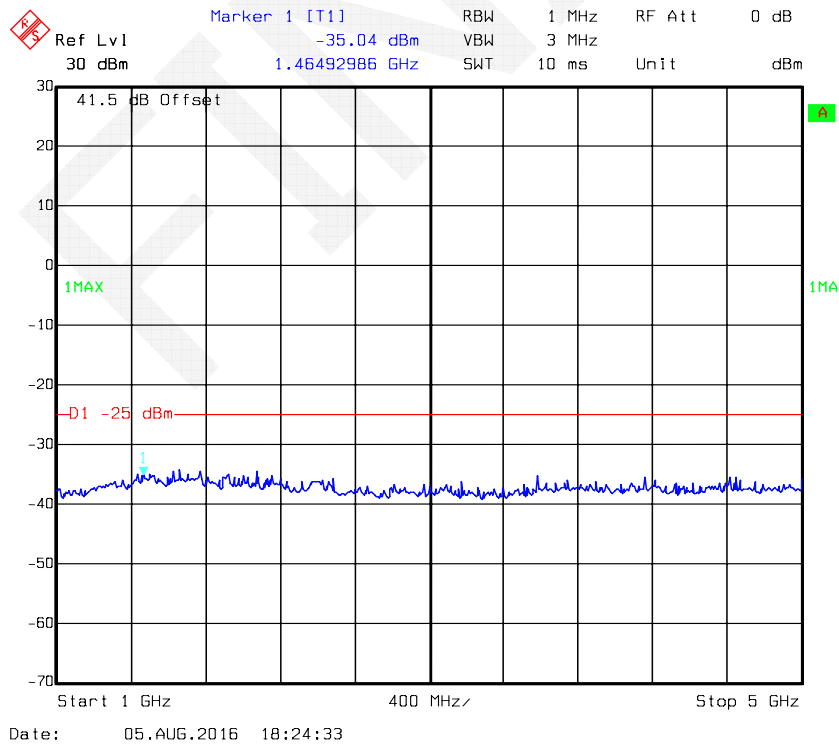
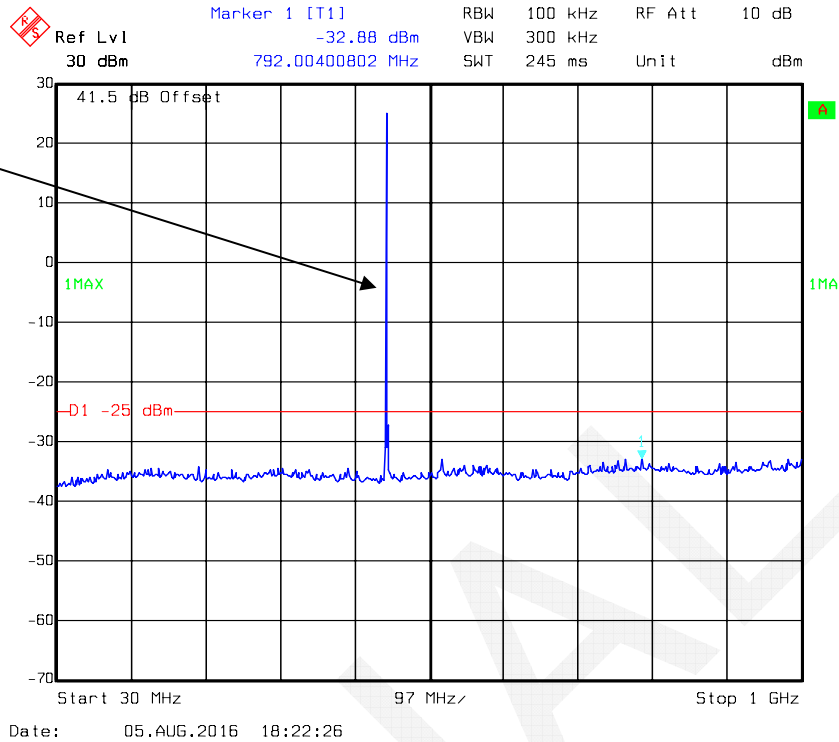
Test Data**Environmental Conditions**

Temperature:	28.4°C
Relative Humidity:	53%
ATM Pressure:	100kPa

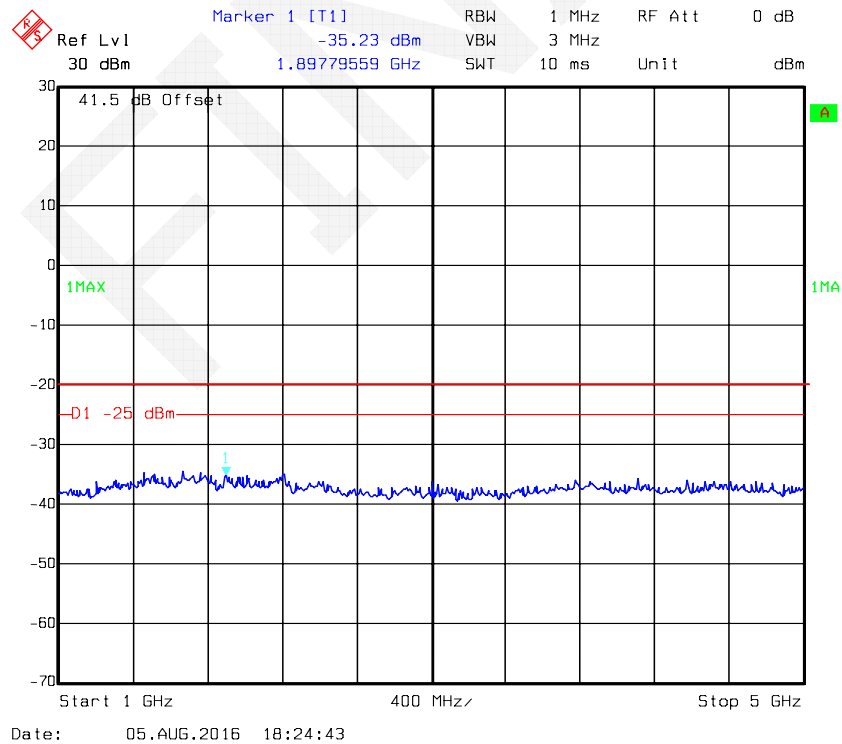
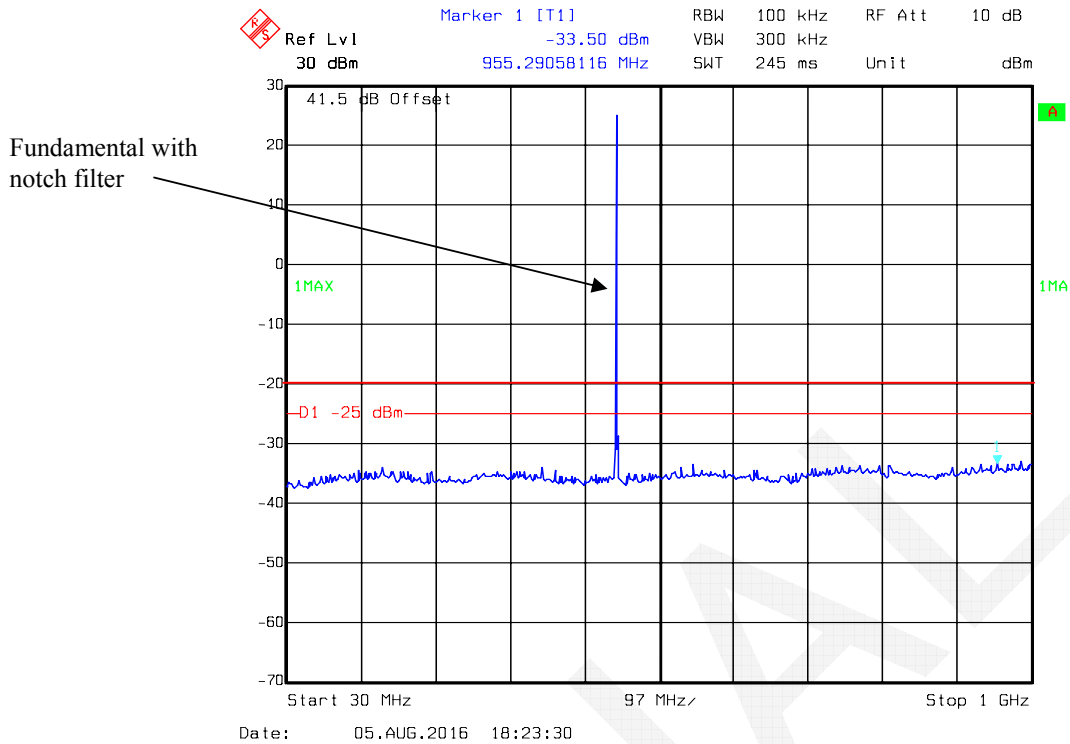
The testing was performed by Costa Dong on 2016-08-05.

Note: For conducted spurious emissions were tested at high rated power, which was the worst case.

460.0125 MHz – FM Mode, 6.25 kHz



460.0125 MHz FM Mode, 12.5 kHz



FCC §2.1053 & §90.210 - RADIATED SPURIOUS EMISSIONS

Applicable Standard

FCC §2.1053 and §22.359 and §90.210

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
HP	Signal Generator	1026	320408	2015-11-23	2016-11-22
R&S	EMI Test Receiver	ESCI	100224	2016-08-03	2017-08-02
Sunol Sciences	Antenna	JB3	A060611-3	2014-11-06	2017-11-05
HP	Amplifier	8447E	2434A02181	2015-09-01	2016-09-01
Agilent	Spectrum Analyzer	E4440A	SG43360054	2015-11-23	2016-11-22
ETS-Lindgren	Horn Antenna	3115	9808-5557	2015-09-06	2018-09-06
Mini-Circuit	Amplifier	ZVA-213-S+	054201245	2016-02-19	2017-02-19
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2014-06-16	2017-06-15
EMCO	Adjustable Dipole Antenna	3121C	9109-753	N/A	N/A
N/A	Coaxial Cable	14m	N/A	2016-05-06	2017-05-06
N/A	Coaxial Cable	8m	N/A	2016-05-06	2017-05-06
Mini-Circuits	HIGH PASS FILTER	BHP-550+	YZU15801121	2016-05-06	2017-05-06
Weinschel Corp	Terminal Load(100W)	1440-3	MD447	/	/

* **Statement of Traceability:** Bay Area Compliant Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load, which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

For part 90:

Spurious emissions in dB = $10 \log_{10}(\text{TXpwr in Watts}/0.001)$ - the absolute level

Spurious attenuation limit in dB = $50 + 10 \log_{10}(\text{power out in Watts})$ for EUT with a 12.5 kHz channel bandwidth.

Test Data**Environmental Conditions**

Temperature:	30.6°C
Relative Humidity:	51%
ATM Pressure:	99.6kPa

The testing was performed by Costa Dong on 2016-08-05.

Test Mode: Transmitting-High power level is the worst case.

FM Mode-6.25kHz:

Frequency (MHz)	Polar (H/V)	Receiver Reading (dBμV)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			S.G. Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
Frequency: 460.0125 MHz								
920.025	H	33.12	-40.7	0.0	1.0	-41.7	-25.0	16.7
920.025	V	36.74	-33.8	0.0	1.0	-34.8	-25.0	9.8
1380.038	H	41.23	-59.3	8.8	1.4	-51.9	-25.0	26.9
1380.038	V	42.52	-57.8	8.8	1.4	-50.4	-25.0	25.4
1840.050	H	38.58	-61.2	11.4	1.3	-51.1	-25.0	26.1
1840.050	V	42.05	-57.8	11.4	1.3	-47.7	-25.0	22.7
2300.063	H	34.70	-61.5	11.2	2.3	-52.6	-25.0	27.6
2300.063	V	36.39	-59.4	11.2	2.3	-50.5	-25.0	25.5
2760.075	H	38.56	-59	13.1	2.3	-48.2	-25.0	23.2
2760.075	V	39.92	-58.4	13.1	2.3	-47.6	-25.0	22.6
3220.088	H	39.73	-57.7	13.6	2.2	-46.3	-25.0	21.3
3220.088	V	41.77	-54.9	13.6	2.2	-43.5	-25.0	18.5
3680.100	H	35.52	-59.4	14.0	2.3	-47.7	-25.0	22.7
3680.100	V	40.22	-54.3	14.0	2.3	-42.6	-25.0	17.6

FM Mode-12.5kHz:

Frequency (MHz)	Polar (H/V)	Receiver Reading (dBμV)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			S.G. Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
Frequency: 460.0125 MHz								
920.025	H	35.68	-38.2	0.0	1	-39.2	-20.0	19.2
920.025	V	38.78	-31.8	0.0	1	-32.8	-20.0	12.8
1380.038	H	41.70	-58.8	8.8	1.4	-51.4	-20.0	31.4
1380.038	V	42.82	-57.5	8.8	1.4	-50.1	-20.0	30.1
1840.050	H	38.68	-61.1	11.4	1.3	-51.0	-20.0	31.0
1840.050	V	41.73	-58.1	11.4	1.3	-48.0	-20.0	28.0
2300.063	H	34.57	-61.7	11.2	2.3	-52.8	-20.0	32.8
2300.063	V	35.87	-59.9	11.2	2.3	-51.0	-20.0	31.0
2760.075	H	39.24	-58.4	13.1	2.3	-47.6	-20.0	27.6
2760.075	V	39.80	-58.6	13.1	2.3	-47.8	-20.0	27.8
3220.088	H	39.48	-58	13.6	2.2	-46.6	-20.0	26.6
3220.088	V	40.96	-55.7	13.6	2.2	-44.3	-20.0	24.3
3680.100	H	36.27	-58.7	14.0	2.3	-47.0	-20.0	27.0
3680.100	V	40.32	-54.2	14.0	2.3	-42.5	-20.0	22.5

Note1: The unit of Antenna Gain is dBd for frequency below 1GHz, and the unit of Antenna Gain is dBi for frequency above 1GHz.

Note2: Absolute Level = SG Level - Cable loss + Antenna Gain
Margin = Limit-Absolute Level

FCC §2.1055 & §90.213- FREQUENCY STABILITY

Applicable Standard

FCC §2.1055, §90.213

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2015-11-23	2016-11-22
Dongzhixu	High Temperature Test Chamber	DP1000	201105083-4	2015-09-10	2016-09-09
UNI-T	Multimeter	UT39A	M130199938	2016-04-10	2017-04-10
AA-MCS	Attenuator(40dB)	CAT-50-40-200-Nm-Nf	0602-010	2016-05-08	2017-05-08
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2016-05-06	2017-05-06
N/A	Coaxial Cable	0.1m	N/A	2016-05-06	2017-05-06

* **Statement of Traceability:** Bay Area Compliant Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to DC power supply and the RF output was connected to a frequency counter via feed-through attenuators. The EUT was placed inside the temperature chamber. The power leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the counter.

The frequency stability shall be measured with variation of primary supply voltage as follows:

- (1) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

Test Data

Environmental Conditions

Temperature:	28.4°C
Relative Humidity:	53 %
ATM Pressure:	100kPa

The testing was performed by Costa Dong on 2016-08-05.

Test Mode: Transmitting

Reference Frequency: 460.0125 MHz, 6.25 kHz, Limit: 1.0 ppm			
Temperature	Voltage	Reading	Frequency Error
°C	V _{DC}	MHz	ppm
-30	12	460.012581	0.18
-20		460.012549	0.11
-10		460.012562	0.13
0		460.012428	-0.16
10		460.012445	-0.12
20		460.012518	0.04
30		460.012439	-0.13
40		460.012590	0.20
50		460.012576	0.17
25	13.8	460.012418	-0.18
	10.2	460.012550	0.11

Reference Frequency: 460.0125 MHz, 12.5 kHz, Limit: 2.5 ppm			
Temperature	Voltage	Reading	Frequency Error
°C	V _{DC}	MHz	ppm
-30	12	460.012437	-0.14
-20		460.012375	-0.27
-10		460.012392	-0.23
0		460.012619	0.26
10		460.012607	0.23
20		460.012464	-0.08
30		460.012447	-0.12
40		460.012484	-0.03
50		460.012470	-0.07
25	13.8	460.012596	0.21
	10.2	460.012359	-0.31

FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR

Applicable Standard

Regulations: FCC §90.214

Test method: ANSI/TIA-603-D 2010, section 2.2.19.3

Test Equipment List and Details

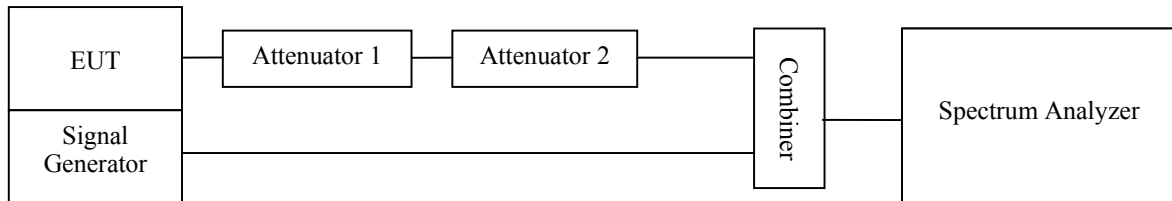
Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSEM	DE31388	2016-05-09	2017-05-09
HP	Signal Generator	E4422B	MY41000355	2015-11-23	2016-11-22
Cheng Du Ou Li Tong	Two way power splitter	EMPD-T- 2-10-1000	OE01201041	2016-05-06	2017-05-06
AA-MCS	Attenuator(40dB)	CAT-50- 40-200- Nm-Nf	0602-010	2016-05-08	2017-05-08
E-Microwave	DC Blocking	EMDCB- 00036	0E01201047	2016-05-06	2017-05-06

* Statement of Traceability: Bay Area Compliant Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

- Connect the EUT and test equipment as shown on the following block diagram.
- Set the Spectrum Analyzer to measure FM deviation, and tune the RF frequency to the transmitter assigned frequency.
- Set the signal generator to the assigned transmitter frequency and modulate it with a 1 kHz tone at ± 12.5 kHz deviation and set its output level to -100dBm.
- Turn on the transmitter.
- Supply sufficient attenuation via the RF attenuator to provide an input level to the Spectrum Analyzer that is 40 dB below the maximum allowed input power when the transmitter is operating at its rated power level. Note this power level on the Spectrum Analyzer as P_0 .
- Turn off the transmitter.
- Adjust the RF level of the signal generator to provide RF power equal to P_0 . This signal generator RF level shall be maintained throughout the rest of the measurement.
- Remove the attenuation 1, so the input power to the Spectrum Analyzer is increased by 30 dB when the transmitter is turned on.
- Adjust the vertical amplitude control of the spectrum analyzer to display the 1000 Hz at ± 4 divisions vertically centered on the display. Set trigger mode of the Spectrum Analyzer to "Video", and tune the "trigger level" on suitable level. Then set the "trigger offset" to -10ms for turn on and -15ms for turn off.
- Turn on the transmitter and the transient wave will be captured on the screen of Spectrum Analyzer. Observe the stored display. The instant when the 1 kHz test signal is completely suppressed is considered to be t_{on} . The trace should be maintained within the allowed divisions during the period t_1 and t_2 .

- k) Then turn off the transmitter, and another transient wave will be captured on the screen of Spectrum Analyzer. The trace should be maintained within the allowed divisions during the period t_3 .



Test Data

Environmental Conditions

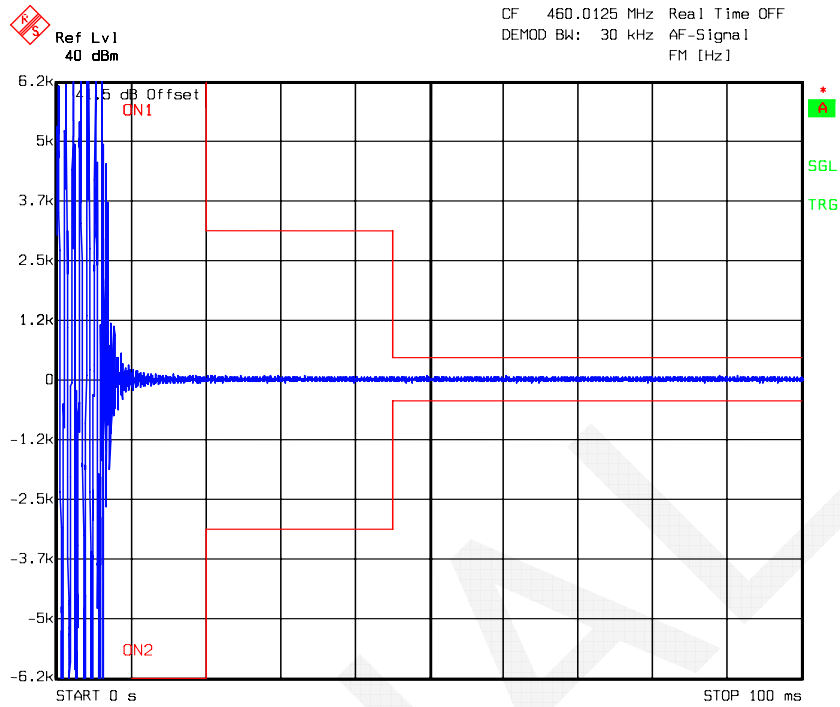
Temperature:	28.6°C
Relative Humidity:	51 %
ATM Pressure:	100kPa

The testing was performed by Costa Dong on 2016-08-10.

Channel Spacing (kHz)	Transient Period (ms)	Maximum frequency difference	Result
12.5	$<10(t_1)$	± 12.5 kHz	Pass
	$<25(t_2)$	± 6.25 kHz	
	$<10(t_3)$	± 12.5 kHz	
6.25	$<10(t_1)$	± 6.25 kHz	Pass
	$<25(t_2)$	± 3.125 kHz	
	$<10(t_3)$	± 6.25 kHz	

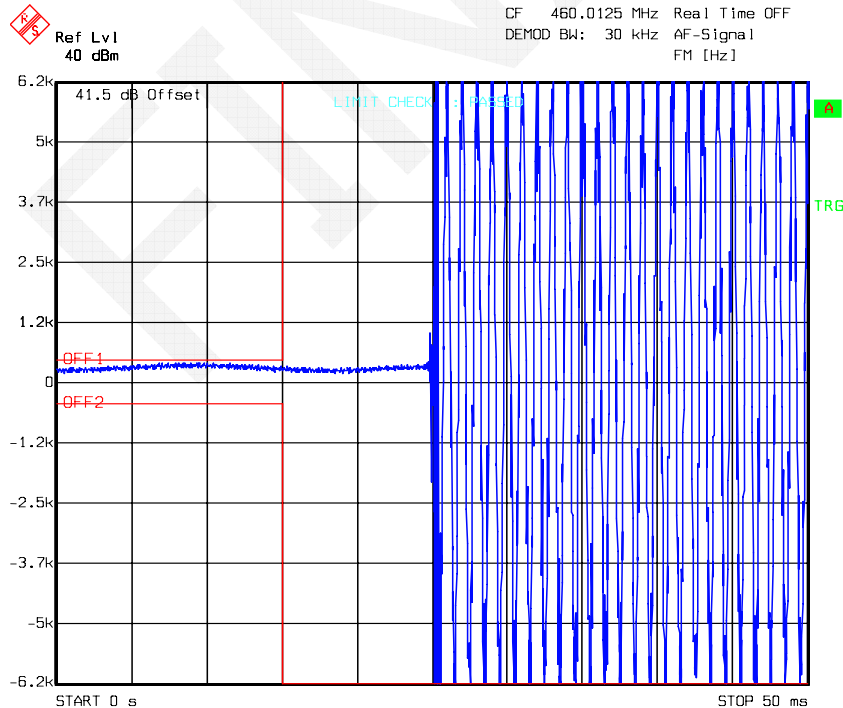
Please refer to the following plots.

Turn on – 460.0125MHz, FM Mode, Channel Spacing: 6.25 kHz



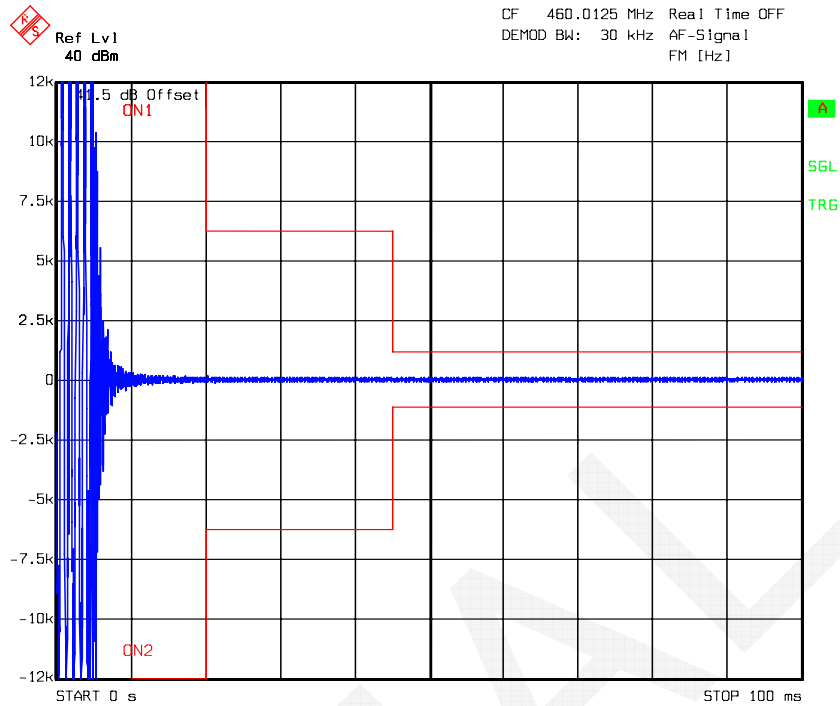
Date: 10.AUG.2016 17:22:43

Turn off – 460.0125MHz, FM Mode, Channel Spacing: 6.25 kHz



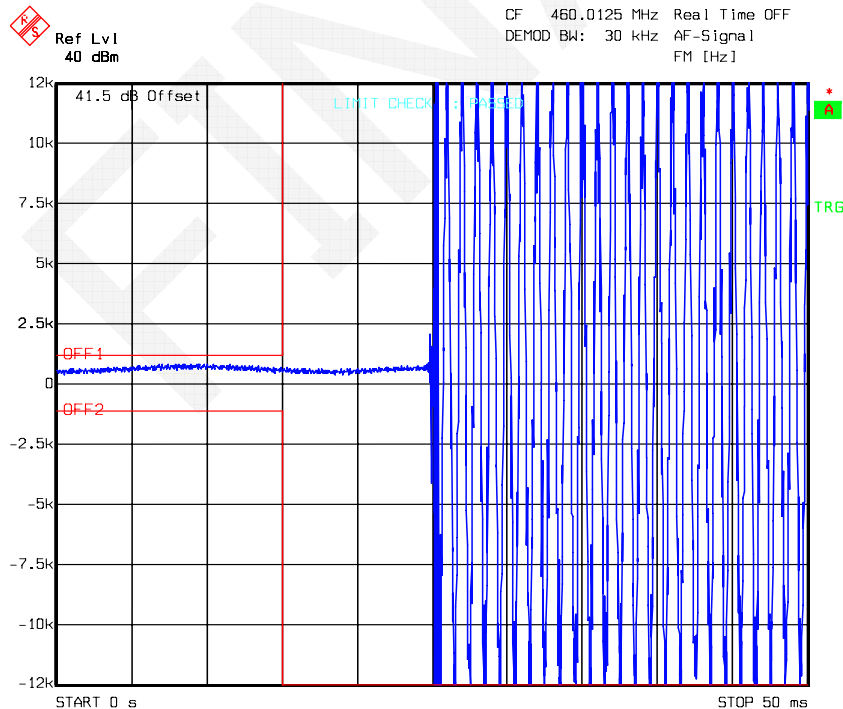
Date: 10.AUG.2016 17:34:52

Turn on – 4460.0125MHz, FM Mode, Channel Spacing: 12.5 kHz



Date: 10.AUG.2016 17:44:47

Turn off – 460.0125MHz, FM Mode, Channel Spacing: 12.5 kHz



Date: 10.AUG.2016 17:38:25

**** END OF REPORT ****